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Irregular Growth of Outplanted Red Pine
III. The Influence of Handling and Planting on Second-Year Performance

by

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An earlier note (Pierpoint et al. 1977) reported the establishment and first-year results of an outplanting experiment. The performance of regular 3+0 red pine (*Pinus resinosa* Ait.) nursery stock, handled from the nursery and planted in the field with considerable care by research staff, was tested and compared with the performance of similar stock handled and planted during normal district operations. The comparison showed reduced survival, height growth and/or quality of leader in many district operations, attributable to handling and planting techniques.

This new note reports and compares the survival and height growth for the second growing season and the accumulated two-year growth.

Procedures

The eleven plantings were conducted during the spring, 1976, planting season in six districts; that is, on two dates (early and late) in each of five districts and on one date (late) in the sixth. Three 100-tree plots were located within each research and district planting. A full description of the experimental design and first-year procedure is provided by Pierpoint et al. (1977). Second-year survival and height growth were measured in late 1977. Plot survival values with square root transformation and plot mean height growth for 1977 and accumulated 1976+77 were compared between district and research plantings by analysis of variance.

Results and Discussion

The results are shown in Table 1. Second-year survival continued to show at least a reasonable success in every planting, with only four plantings (from three districts) having less than 80% survival. In nine of the eleven district-versus-research comparisons, second-season mortality was greater in

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TABLE 1 Influence of handling and planting on survival and growth of 1976 outplanted red pine: second-year results[a]

Code[b]	Survival %	F	1977 Height growth Total cm	Total % [c]	Mean cm	F	1976 + 1977 Height growth Total cm	Total % [c]	Mean cm	F
AKDE	85	28.0**	1358		5.3	4.3	3242		12.7	39.1***
AKRE	95		1802	133	6.3		4635	143	16.3	
AKDL	77	48.0***	503		2.2	4.6	1630		7.1	13.4*
AKRL	93		978	194	3.5		3024	186	10.8	
BMDE	72	47.6***	538		2.5	75.7***	1461		6.8	170.3***
BMRE	98		1797	334	6.1		4048	277	13.8	
BMDL	74	4.7	950		4.3	18.7*	1784		8.1	50.5***
BMRL	98		2028	213	6.9		4300	241	14.6	
CKDL	87	1.3	1516		5.8	5.4	3314		12.7	28.5**
CKRL	82		1681	111	6.8		4083	123	16.5	
HMDE	81	32.1***	832		3.4	6.2	2318		9.5	18.0*
HMRE	97		1259	151	4.3		3778	163	13.0	
HMDL	80	9.8*	688		2.9	38.4***	1850		7.7	91.5***
HMRL	98		1939	282	6.6		4376	237	14.8	
LODE	90	1.4	2020		7.5	36.0***	4244		15.7	1.8
LORE	94		1612	80	5.7		4247	100	15.1	
LODL	97	0.3	1610		5.6	0.0	4227		14.6	0.1
LORL	95		1595	99	5.6		3998	95	14.0	
TODE	80	1.5	1254		5.2	2.9	2199		9.1	7.4
TORE	87		1556	124	6.0		3276	149	12.6	
TODL	70	7.5	454		2.1	7.6	1444		6.8	18.5*
TORL	86		1152	254	4.4		3178	220	12.3	
	81	DISTRICT -:GRAND TOTALS:-				DISTRICT	27713			
	93	RESEARCH				RESEARCH	42943	155		

[a] Mean growth values are based on three "100-tree" plots; total growth values are adjusted for exactly 300 trees.

[b] Identifies planting;- letters show district, nursery stock, handling and planting crew, planting time:

District		Nursery		Crew		Time	
A	Algonquin Park	M	Midhurst	D	District	E	Early
B	Blind River	O	Orono	R	Research	L	Late
C	Cornwall	K	Kemptville				
H	Huronia						
L	Lindsay						
T	Tweed						

[c] $\frac{\text{"Research" growth}}{\text{"District" growth}} \times 100$

* Significant at 5% level (F > 7.7)
** " " 1% " (" > 21.2)
*** " " 0.5% " (" > 31.3)

the district planting, but none was more than seven percent. After two growing seasons, then, district survival values were significantly lower than research survival values in five of the eleven comparisons, were non-significantly lower in four comparisons and were non-significantly higher in two comparisons. Overall survivals were: district, 81%; research, 93%.

Mean height growth continued to be less in the second season in nine of the eleven district plantings, compared with the appropriate research plantings, although the differences were statistically significant in only three of these comparisons. A tenth comparison showed identical growth and the remaining comparison (Lindsay early) showed the district 1977 mean height growth to be significantly greater than the research growth, which is the reverse of the 1976 relationship. Total second-season height growth of the trees surviving in the plots showed research values ranging from 80% to 334% of the district values.

The sum of first- and second-year height growth, which represents the effective performance of the trees since planting, showed a lower value of both mean and total growth in nine of the eleven district plantings, compared with the research plantings. The differences in mean growth were significant in eight of the eleven comparisons. Total height growth on research plots ranged from 95% to 277% of the district values.

Mean height growth was less in the second season than in the first season in twenty of the twenty two plantings, the two exceptions being district plantings (BMDL and TODE). We expected this and consider it typical of most red pine outplantings, based on many previous observations. This *reduction* in second season mean height growth was greater in eight and less in three of the research plantings compared with district plantings, based on the *absolute* (cm) values. Expressing this mean height reduction as a *percentage* of the first season's mean height, we find that the reduction was greater in only six (not eight) and less in five (not three) of the research plantings compared with district plantings. Thus the absolute differences between district and research mean height growth, which were mostly very highly significant after the first season (Pierpoint et al. 1977), were somewhat mitigated during the second season. Nevertheless, at the end of the second season, the percentage by which the total of the two years of height growth of *all* research trees was greater than that of *all* district trees was almost identical to the first-season percentage. This, of course, reflects also the greater second-season mortality in the district plots. An analysis for each comparison shows this second-season percentage (research over district total growth) to be reduced in six places but increased in the other five, from the first-year values.

During the annual monitoring of survival and growth on the plots, the quality of each seedling's leader is being classified to provide more data for predicting the future performance of recently-outplanted seedlings, as outlined by Fayle and Pierpoint (1978). We anticipate that the surviving trees having normal or longer-than-normal needles on the 1977 leader will perform better in 1978, the third growing season, than will those trees having shorter-than-normal needles. The percentage of these "better" trees varies from 49% to 98% in the district plantings, with an overall value of 72%, and from 63% to 100% in the research plantings, with an overall value of 85%. Next year's growth will be studied in relation to these quality ratings.

In conclusion, after two growing seasons there are still definite reductions in survival and height growth which are attributable to handling

and planting techniques currently used in many district operations. The comparative plantings will continue to be monitored to see if differences decrease or increase in future growing seasons.

Acknowledgement

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